NEW ENGLAND RIVER BASINS COMMISSION
CONNECTICUT RIVER BASIN PROGRAM
SUPPLEMENTAL FLOOD MANAGEMENT STUDY

PHASE 2 (PARTIAL) PRESENTATION AND EVALUATION OF STRUCTURAL ELEMENTS IN FLOOD DAMAGE REDUCTION ALTERNATIVE PLANS

Prepared by the New England Division
U. S. Army Corps of Engineers
Supplemental Study Phase 2

1 April 1975

CONNECTICUT RIVER SUPPLEMENTAL STUDY
PHASE 2 REPORT
CORPS OF ENGINEERS

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1. BACKGROUND

The Corps of Engineers, as part of the Connecticut River Supplemental Study, has the responsibility of investigating structural elements of alternative flood damage reduction plans in the Connecticut River. Work is defined in New England River Basins Commission, Connecticut River Basin Program, Supplemental Flood Management Study, PLAN OF STUDY, July 1, 1973, Sections COE 2.1 C, 2.1 D, and 2.1 E. This report is intended to transmit the findings of the Corps of Engineers along with certain recommendations to the New England River Basins Commission.

The report is not intended for general distribution. As mentioned, only certain elements of various flood damage reduction alternatives were investigated, and these elements of the work are reported upon here. Other elements of the investigation are being handled by other organizations, and it is understood that the New England River Basins Commission will use this partial report along with reports of others to develop a Connecticut River Basin flood damage reduction plan.

Structural flood damage reduction alternatives discussed in this report have been analyzed in a detail which is in keeping with the purpose of the Connecticut River Supplemental Study; that is to develop a conceptual basin-wide flood damage reduction plan. Engineering studies on these elements have not been accomplished in the detail necessary to recommend specific projects for Congressional authorization. It should be noted that prior to implementation, detailed engineering, economic, environmental and social studies will be accomplished on each element of any Connecticut River Supplemental Study recommended plan.

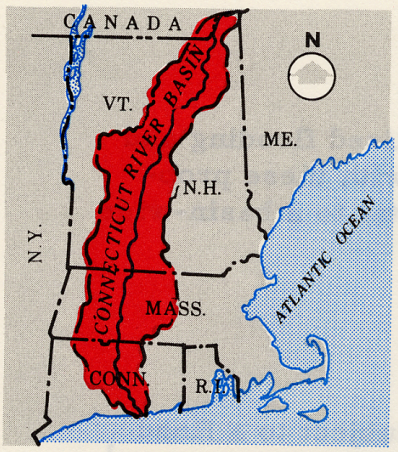
2. COORDINATION

Areas of responsibility in Phase 2 of the Supplemental Study as defined in the Plan of Study are fragmented. The Corps of Engineers responsibility involves the investigation of certain structural elements in alternative flood damage reduction plans. Since several organizations were working on various elements of a number of flood control plans, considerable effort was expended in interdisciplinary coordination. Frequent meetings were held among Study Management Team members. Various plans were aired before the public at a series of meetings held in July and August 1974. Countless individual contacts were made to seek and provide information. Aside from the specific work items which it was charged with accomplishing, the Corps of Engineers was called upon to furnish information which it had available and was considered necessary to make evaluations of environmental, social and economic impacts.

3. STUDY AREA

The entire Connecticut River Watershed, in Connecticut, Massachusetts, New Hampshire and Vermont, is considered the study area. The map on the following page shows the Basin with major, existing Corps of Engineers projects. The watershed was subdivided for impact studies of Corps of Engineers elements of the work as: Lower Basin (Connecticut and Massachusetts); Ashuelot River, New Hampshire; Sugar River, New Hampshire; Ammonoosuc River, New Hampshire; and White River, Vermont. The specific tributaries were selected because the 1970 Coordinating Committee recommendations included flood control projects (large reservoirs) on them. The Coordinating Committee also recommended flood control projects on the Deerfield River, Massachusetts, and the Passumpsic River, Vermont. Impacts on the Deerfield River were considered in lower Basin impact evaluations and the Passumpsic River impacts were handled in conjunction with the Soil Conservation Service's upstream watershed studies on that tributary.

This investigation and report are intended to address basin-wide flood problems. Alternative flood damage reduction plans are intended to primarily alleviate mainstem Connecticut River problems. Where possible, tributary problem areas are addressed as part of the basin-wide consideration. The Corps of Engineers has



CANADA

VT.

N

N.H.

MAINE

VT.

N.H.

Upper Ammonoosuc R.

Moose R.

Passumpsic R.

St. Johnsbury

Ammonoosuc R.

Woodsville

CONNECTICUT RIVER

Ompompanoosuc R.

White R.

HARTFORD

Ottauquechee R.

Mascoma R.

UNION VILLAGE DAM

Hartland

NORTH HARTLAND LAKE

WESTON

Black R.

Claremont

Sugar R.

NORTH SPRINGFIELD LAKE

Springfield

CHARLESTOWN (Not Completed)

BALL MOUNTAIN LAKE

West R.

SURRY MOUNTAIN LAKE

TOWNSHEND LAKE

VT.

N.H.

CONNECTICUT RIVER

OTTER BROOK LAKE

Brattleboro

Ashuelot R.

KEENE

VT.

MASS.

TULLY LAKE

N.H.

MASS.

Deerfield R.

Millers R.

BIRCH HILL DAM

Greenfield

Athol

GARDNER

NORTHAMPTON

KNIGHTVILLE DAM

LITTLEVILLE LAKE

HUNTINGTON

HOLYOKE

CHICOPEE

CHICOPEE FALLS

WEST SPRINGFIELD

BARRE FALLS DAM

Ware R.

WARE

Quaboag R.

WEST WARREN

THREE RIVERS

Westfield R.

Chicopee R.

MASS.

CONN.

COLEBROOK RIVER LAKE

MAD RIVER DAM

WINSTED

SUCKER BROOK DAM

PARK RIVER (Not Completed)

Farmington R.

CONANT BROOK DAM

SPRINGFIELD

HARTFORD

EAST HARTFORD

New Britain

WETHERSFIELD COVE

HARTFORD TO LONG ISLAND SOUND

EIGHTMILE RIVER

New London

New Haven

ESSEX COVE

NORTH COVE

OLD SAYBROOK

LONG ISLAND SOUND

LEGEND

- RESERVOIRS
- LOCAL PROTECTION PROJECT
- NAVIGATION PROJECT

CONNECTICUT RIVER BASIN
New Hampshire, Vermont, Massachusetts & Connecticut

SCALE IN MILES

8 0 8 16 24

on-going programs to cope with problems of localized flooding and ice jamming. This report will not be concerned with these problems except in areas where they might be incidental to a basin-wide plan.

4. THE PROBLEM

Many Connecticut River Basin communities are subject to a flood threat. The threat was considered by the Coordinating Committee[1] to be of major proportions. The Coordinating Committee included, among their many water resource recommendations, a 1980 plan for reducing flood losses. The plan consisted of constructing seven large reservoirs along with an upstream watershed plan, five local protection projects, and associated non-structural measures. The latter element was intended to complement structural elements of the plan and was geared principally toward preventing the flood loss potential from worsening in future years. An alternative system of raising existing dikes and constructing new dikes was also presented by the Coordinating Committee.

A Citizens Review Committee along with the New England River Basins Commission reviewed the Coordinating Committee Report and raised several objections in the area of flood control. The objections which are documented in two reports[2] fall under three general headings. It was felt by many reviewers that:

1. The need for additional flood damage reduction measures was not clear.

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[1] The Connecticut River Basin Coordinating Committee was an 11 member Federal/State/New England River Basin Commission organization that conducted a 6-year comprehensive water resource study and published a report, Comprehensive Water and Related Land Resources Investigation, Connecticut River Basin, June 1970. Appendices C, F, J, K and M of the report dealt partially or wholly with the matter of flood damage reduction.

[2] Report of the Citizens Review Committee on the Connecticut River Basin Comprehensive Water and Related Land Resources Investigation, February 1, 1971, and the NERBC 1980 Connecticut River Basin Plan, January 1, 1972.

2. Alternative means of accomplishing necessary flood damage reduction were not adequately presented.

3. Environmental Impacts of the recommended flood damage reduction plan were not adequately evaluated.

The Corps of Engineers responsibility in the Supplemental Study and this report, along with the Corps Phase 1 report,[1] address certain elements in the first two criticisms above. The Phase 1 report dealt with defining the need for additional flood protection. Separate investigations were conducted in 18 communities within the Basin, and flood problems were documented along with measures taken in the past to deal with the problem. The study and report confirmed the fact that flooding is a major problem in the Basin.

The Coordinating Committee report and the Corps Phase 1 Supplemental Study Report are both in agreement that overtopping mainstem Connecticut River local protective works would cause catastrophic losses. The areas behind the protective works are generally among the most heavily developed and prosperous in the Basin. Aside from Westfield, Massachusetts, each of the remaining 10 communities studied in Phase 1 would suffer light to moderate damage relative to the community's total value, and only light damage relative to the Hartford and Springfield metropolitan areas. The City of Westfield would suffer severe damage from a major flood.

The 1970 Coordinating Committee Report recommended the construction of seven multiple purpose reservoirs which would contain provisions for floodwater storage. The report further said that raising six of the seven existing mainstem local protection projects was a physically viable, although less economically efficient, alternative. The supplemental study confirmed that constructing reservoirs or reconstructing the dikes to a higher level are the only feasible structural measures to alleviating the threat of flooding behind the dikes at the six existing mainstem local protection

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[1] New England River Basins Commission, Connecticut River Basin Program, Supplemental Flood Management Study, Phase 1, Assessment of the Flood Damage Reduction Performance of the Existing Flood Control System in the Connecticut River Basin, Corps of Engineers, 1 July 1974.

projects. However, in view of the existing political, environmental and philosophical opposition to large reservoirs, it was decided to pursue the concept of reconstructing the existing mainstem dikes. While the system of reservoirs is the more economically efficient approach, it is recognized that the premium price paid for added protection by raising the dikes might be more appropriate since this premium price might buy a program that could be considerably less upsetting from an environmental and social point of view.

Not surprisingly, it became evident early in the study that non-structural techniques would play an important part of any solution which would be contemplated. The New England River Basins Commission, as part of its work, developed (through contract) wholly non-structural alternatives to address the problem of potential mainstem Connecticut River flood loss.

Structural measures, obviously, will not solve all problems, but there is an even more important reason for considering non-structural elements as necessary, especially when considering alternative plans with reservoirs. An expansion of the existing reservoir system will permit flood stages to be significantly reduced. Areas that now can expect frequent flooding will be in a position where they will be affected only by a rare flood. Development in these areas may become an attractive venture considering the lowered risk of flooding. Thus, the reservoirs could actually encourage streamside development. Non-structural measures in such a case must be implemented so that future development will not negate the damage reduction accomplished by the reservoirs.

Dike construction, on the other hand, may solve flood problems in one particular area. Any protection that is to be offered outside of a diked area would be of a non-structural nature.

A problem of major proportions exists in six mainstem Connecticut River communities, where local protective dikes and floodwalls have been built, and an explanation is in order. The 1938 Flood Control Act, Public Law 761 -- 75th Congress, authorized a plan of flood damage reduction. The key elements in the plan were the construction of seven local protection projects on the Connecticut River mainstem and the construction of 20 large flood control reservoirs on upstream tributaries, with 10 alternate sites identified. Subsequent Federal legislation resulted in the authorization

of the system of 27 reservoirs which remain as authorized projects today. The plan presented in the 1938 Flood Control Act was to solve the problem by recommending a diking system to provide protection from a recurrence of a 1936 magnitude flood and the construction of the system of upstream reservoirs so that runoff from a design storm could be reduced to a point where the dikes would not be overtopped. The design storm and resulting design flood as conceived in the 1930's is very similar to today's design flood known as the Standard Project Flood. The 1938 Flood Control Act provided a plan that was considered adequate to provide the necessary protection to the most developed and damage-prone areas in the Basin. If the plan had been carried to completion, the Basin would have the high degree of security that is sought today.

When the city government of Hartford, Connecticut, was presented the plan in the 1930's, it felt that the city's security would be based on the uncertainty of the reservoirs ever being constructed. The city, therefore, negotiated with the Corps of Engineers to have its protective works constructed to the design flood level without considering the reduction of upstream reservoirs. The city contributed $5 million, the additional cost to provide the additional protection to the project. The dikes at Hartford are now six feet higher than the East Hartford dikes, immediately across the Connecticut River. This additional height was provided by Hartford's investment. Today, the City of Hartford is considered safe from a Standard Project Flood.

Hartford's concern about the construction of upstream reservoirs, today, appears well founded. Sixteen tributary reservoirs have been constructed. Thirteen of these reservoirs are effective in reducing Connecticut River flood stages at the Hartford/East Hartford local protection projects. Twelve are effective in reducing flood stages at the local protection projects in Springfield, West Springfield, Holyoke, Chicopee and Northampton, Massachusetts. However, the level of tributary control, envisioned in the 1930's has never been realized. The local protection projects at East Hartford, Connecticut; and Springfield, West Springfield, Holyoke, Chicopee, and Northampton, Massachusetts, do not now have the level of protection that was authorized by the 1938 Flood Control Act. A Standard Project Flood would overtop all of these projects, causing catastrophic losses.

5. FIELD INVESTIGATIONS

The Phase 1 report indicated that overtopping of the mainstem dikes would cause catastrophic losses. A review of the hydrology done for the Coordinating Committee Study confirmed that a flood of major proportions could, in fact, overtop six of the mainstem protective works. It was decided that a closer look should be made of the areas which are presently protected by these projects to determine the type and magnitude of development behind them, recent trends and to the extent possible, predict what future development might be expected. Each community was visited, building permits for recent years were examined to locate new construction. A very rough idea of the value of recent construction was established from examining building permits, assessed valuations, and observations. Attachment A contains reports on recent and planned development in the protected areas behind the dikes. One poignant fact developed as a result of this work. Development is sporadic with regard to time and location, examples will become obvious as this development is discussed later on. The lack of uniformity in development makes it difficult to project how loss potential may have changed in recent years and makes it difficult to project the loss potential into the future. With this in mind, the following assessment of recent development and projected growth in the protected area is made.

East Hartford - The area protected by the dikes experienced little growth immediately prior to 1969. A mixed commercial industrial residential area bordered by Connecticut Boulevard, Thomas Street and the dike, as well as a strip of primarily residential development between Prospect Street and Main Street, has survived through the years with little change. An extensive area north of Pitkin Street was used as an interchange for Interstate Route 84. A marsh of about 1000 acres in area bordered by the dike, Prospect, Governor and Thomas Streets, shows little pressure for development.

The whole nature of the area was changed in 1969 with the development of Founders Plaza. Founders Plaza, a banking-insurance complex, was originally contained within a roughly 1000-foot square area bordered by Pitkin Street, Hartland Street, Meadow Street and the dike. Recent construction associated with the Plaza has overflowed in three directions. An eight-story chain motel on East River Drive and new construction on Ash, Pitkin, and Meadow Streets seems to indicate that the high rate of development will

continue at least into the near future. Total investment from 1969 to date, in the protected area of the East Hartford dike, is estimated at $25 - $30 million. Land congruous to the Founders Plaza area, although not plentiful, is sufficient to continue the existing rate of development for several years. Redevelopment of some of the older areas can also be expected. A factor of 1.6 has been assumed, which will update physical conditions in the diked area of East Hartford from 1968 conditions to 1974 conditions.

Springfield - Of the six areas examined, Springfield appears to be the most heavily developed and to have received the most development in recent years. A building boom is the most accurate way of describing growth behind the dike. An estimated $100 million has been invested in the protected area in the past few years.

In the southern portion of the diked area, an urban renewal project centered around a 25-story insurance building explains much of the recent growth. A civic center, motels, a courthouse, a medical building, a medical insurance building, also add to the $60 million worth of recent development in this area.

The northern half of the diked area accounts for the remaining 40% of recent development. About $20 million of low income multiple family housing has been built adjacent to the dike. A school, a medical building and various commercial buildings account for the remaining new development in this area.

Ample room is available for future development in the northern portion of the diked area, but only a very limited amount of vacant land is to be found in the southern portion. However, older areas are now being demolished to make room for new construction. One would have to project the existing high growth rate, at least into the immediate future. A factor of 2.0 has been assumed, which will update physical conditions in the diked area of Springfield from 1968 conditions to 1974 conditions.

West Springfield - The West Springfield local protection project consists of two separate elements. The dike from the Westfield River north to the North End Bridge is called the West Springfield project. To the north, in an area bisected by Interstate Route 91 is the Riverdale project. These heavily developed areas have received what could be described as moderate growth in recent years.

About $5 million has gone into construction in the West Springfield area, while the Riverdale area has experienced about $7 million in construction in the same five years. The West Springfield area development has been scattered. This area does not have the land available for large scale development, and no urban redevelopment plans seem to be in the works.

The Riverdale area, on the other hand, does have adequate land available for future development. Land here has been set aside for commercial and industrial parks. Several large new buildings account for about 80% of recent growth in the area.

The diked areas can probably expect only moderate development in the future and most of that in the Riverdale Section. A factor of 1.4 has been assumed, which will update physical conditions from 1968 to 1974.

Holyoke - The original system of concrete flood walls was constructed in the late 1930's to protect the heavily developed industrial area of Holyoke. The nature of the protected area is little changed since that time. To the south, a section of dike was added in the late 1940's to protect the Springdale section of the city. Growth within the 230 acres protected by the project has been very limited. The Springdale Industrial Park constructed in 1956 is the most recent large undertaking. Two investments of about $1 million each for paper manufacturing facilities and a million dollar waste-water treatment plant account for most of the more recent development in the area. Another treatment plant is planned for completion in 1977. Although an interstate highway by-pass is expected to be built through the protected area in the near future, very little growth is expected, due to the limited land area available for new development. Physical conditions behind the Holyoke project were assumed unchanged from 1968 to 1974.

Chicopee - The Chicopee Local Protection Project extends along the east bank of the Connecticut River, in two separate pieces, above and below the Chicopee River. The project extends up both banks of the Chicopee River near its mouth. The upper portion of the protected area is characterized by dense residential development. In recent years, this area has seen 30 to 35 houses per year constructed in the $30,000 to $70,000 price range. However, this rate of development is expected to ease as available land in the protected area is becoming scarce. About a million dollars was

invested in new multi-family residences along Chicopee Street between 1965 and 1968. There has been some commercial/industrial growth in this area along Chicopee and Meadow Streets. In the past 10 years, a million dollars worth of commercial growth in the form of a shopping center, banks, a storage building and a super market has occurred. A $2-1/4 million school was also built on Meadow Street. Chicopee Street experienced over $100,000 growth in the form of car washes, a shoe repair shop, a cafeteria and additions to a machine shop.

There has been no recent development of significance in the protected area south of the Chicopee River.

The Chicopee Project protected area is expected to continue as primarily a dense residential area with only limited growth. Conditions behind the Chicopee dikes were assumed to have increased too little to warrant a loss potential adjustment from 1968 to 1974.

Northampton - The protected area has experienced a moderate increase in growth in the past five years. Two new high rise multi-family dwellings were constructed at an estimated cost of $2 to $3 million each on Conz Street. Also on Conz Street, nine new apartments valued at $50,000 each and a clubhouse valued at about $20,000 were built.

A new telephone company maintenance building, three office buildings and a motor lodge/restaurant on King Street have a value of about $2 million.

Available land in the protected area is very limited; and because of this, future development is expected to be low. Future development may, however, take place on the extensive vacant land outside of the local protection project. Conditions within the Northampton project were assumed to have increased too little to warrant an adjustment in loss potential from 1968 to 1974.

6. ALTERNATIVE SOLUTIONS

Alternative 1 - Constructing Seven Large Reservoirs

The Coordinating Committee, in its 1970 report, recommended the construction of ten large reservoirs. Seven of these reservoirs had flood control as a major project purpose. These seven reservoirs make up the major structural element of the Coordinating Committee's flood damage reduction plan. The following is a list of the seven reservoirs:

Site	State	Stream	Purpose[1]
Meadow	MA	Deerfield	F
Honey Hill	NH	S. Branch Ashuelot	R, F, A
Beaver Brook	NH	Beaver Brook (Ashuelot)	F, R, W
Claremont	NH	Sugar	R, F, A
Bethlehem Junction	NH	Ammonoosuc	R, F, A
Gaysville	VT	White	F, R, A
Victory	VT	Moose (Passumpsic)	R, F, A

Six of the seven reservoirs are multiple use facilities, whereas the seventh, the Meadow proposal is a single purpose flood control impoundment.

The flood control features included in these reservoirs are precisely as recommended by the Coordinating Committee. Other project purposes were not investigated in this Supplemental Study. The reader is referred to the Coordinating Committee Report for a description of each of these projects, the alternatives considered and the economic analysis.

Cost and benefit calculations were updated to 1974 price levels. Project estimates were updated in areas where changed conditions would affect the estimates; for instance, latest design estimates were used in the case of Beaver Brook and the relocation of a newly constructed wastewater treatment plant was included in the Meadow proposal. Real estate figures were updated to reflect higher land values. Construction costs were updated using the Engineering News Record, Construction Cost Index. Table 1 presents the updated figures.

[1] R - Recreation; F - Flood Damage Reduction; W - Water Supply; A - Downstream Flow Augmentation

TABLE 1

CONNECTICUT RIVER SUPPLEMENTAL STUDY
ALTERNATIVE 1
COST AND BENEFIT INFORMATION

SEPTEMBER 1974 PRICE LEVEL
(in $1,000)

Project	Construction Expenditure	Interest During Construction	Present Worth of Future Recreation	Interest & Amortization	Operation & Maintenance	Major Replacements	Loss of Taxes and Productivity	Total Annual Charges	Total Project Benefits	Benefits/Charge B/C Ratio
New Hampshire										
Bethlehem Junc.	26,400	2,324	147	1,700	107	33	25	1,865	1,848	0.99
Claremont	33,900	2,984	279 1/	2,188	139	41	19	2,387	2,017	0.84
Beaver Brook 2/	5,170	--	--	175	46	15	--	236	379	1.61
Honey Hill	20,100	1,770	--	1,288	115	34	8	1,445	3,239	2.24
Vermont										
Victory	10,900	637	344	697	107	26	11	841	836	0.99
Gaysville	53,200	6,249	442	3,529	107	29	78	3,743	3,753	1.00
Massachusetts										
Meadow	72,700	6,406	--	4,662	98	70	190	5,020	5,650	1.13
TOTAL SYSTEM	222,370	20,370	1,212	14,239	719	248	331	15,537	17,722	1.14

1/ Includes $82,000 for Present Worth of Future Water Quality

2/ Prepared from project design estimate, 3-1/4% Interest Rate authorized.

3/ Although the total system B/C ratio is 1.14, each element in the plan would have to be justified, individually, before that element was implemented.

Alternative 2 - Reconstruction of Existing Dikes

The structural portion of this alternative provides for the reconstruction of existing local protection projects so that they will contain a design level flood.

There are at present seven major federally constructed local flood protection projects along the mainstem of the Connecticut River. These projects are located in Hartford and East Hartford, Connecticut; and Springfield, West Springfield, Chicopee, Holyoke and Northampton, Massachusetts. They were all initiated in the years immediately following the 1936 flood, and were designed to protect these, the largest and most important urbanized areas in the Connecticut Valley from a recurrence of the 1936 flood. In addition, a system of upstream reservoirs was authorized by Congress which would provide an even higher degree of security from flooding. This system, however, has never been completed, and six of the communities remain threatened by a very large flood. Hartford, Connecticut, the seventh community, accepted as a local responsibility at the time of construction the cost of increasing the height of the dikes an additional six feet to provide itself with a high level of protection. With the completion of the modification of the Park River conduit, Hartford will be secure from a flood of the magnitude of a Standard Project Flood (SPF).

Alternative 2 provides for a higher degree of flood protection by reconstructing the existing dikes and floodwalls to Standard Project Flood design levels at the six local protection projects which presently lack this degree of security. Table 2 presents pertinent data, concerning these six dikes and Alternative 2 modifications. The following is a brief description of the existing local protection projects and the measures which would be required to bring these protective works up to SPF design levels.

East Hartford, Connecticut - The East Hartford local protection project consists of over 20,300 feet of dikes and floodwalls, and protects approximately 760 acres of highly developed urban area from the flood waters of the Connecticut and Hockanum Rivers. There are two sections of earthen dike, 9,458 feet and 10,131 feet long, and two sections of concrete floodwall, 550 feet and 200 feet long. In addition, there are two stop log structures -- one at the Connecticut River railroad bridge and the other at Main Street. Three pumping stations have been provided to handle

TABLE 2

CONNECTICUT RIVER SUPPLEMENTAL STUDY
EXISTING FEDERAL LOCAL PROTECTION PROJECTS AND ALTERNATIVE 2 MODIFICATIONS

	HARTFORD	EAST HARTFORD	SPRINGFIELD	WEST SPRINGFIELD	CHICOPEE	HOLYOKE	NORTHAMPTON
Number and Length of Dikes (feet)	(1) 16,800 (1) 1,420 (1) 3,500 (1) 12,500	(1) 9,458 (1) 10,131	(1) 3,245 (1) 410 (1) 240	(1) 3,440 (1) 2,016 (1) 585 (1) 9,549 (1) 644 (1) 3,175 (1) 217 (1) 12,830	(1) 500 (1) 18,768 (1) 320 (1) 713 (1) 400	(1) 3,730 (1) 150 (1) 160 (1) 56	(1) 3,675 (1) 960 (1) 1,060 (1) 700
Number and Length of Concrete Walls (feet)	(1) 2,107 (1) 896 (1) 1,244 (1) 190	(1) 550 (1) 200	(1) 983 (1) 740 (1) 755 (1) 3,120 (1) 5,720	(1) 2,260 (1) 480 (1) 110 (1) 860 (1) 240	(1) 920 (1) 1,800 (1) 815 (1) 130 (1) 260 (1) 2,190	(1) 5,600 (1) 5,000 (1) 2,262 (1) 3,681 (1) 540	(1) 450
Pumping Stations	6	3	6	5	6	7	1
Number and Type of Gates	(2) Backwater (11) Sluice (8) Sluice-Pump Sta	(4) Sluice	(7) Sluice (20) Backwater (2) Flap	(8) Sluice (7) Sluice-Pump Sta (1) Sewer	(4) Tailrace (3) Sluice (11) Sluice-Pump Sta	(26) Tailrace (16) Flood (17) Sluice	(1) Sluice-Pump Sta (2) Flap
Number and Length of Stop Log Structures (feet)	(1) 31 (1) 14 (1) 19 (1) 15 (1) 6 (1) 18	(1) 19 (1) 80	(1) 10 (2) 12 (2) 18	(3) 15 (1) 52 (1) 74 (1) 93	(1) 19 (1) 31 (1) 36	(3) 20 (1) 19 (2) 16 (2) 4 (1) 22 (5) 32 (1) 18 (1) 21	(1) 31 (1) 46 (1) 50
Number and Length of Pressure Conduits (feet)	(1) 5,600 (1) 3,100 (1) 2,200		(1) 1,600				
Maximum Height of Existing Structure (feet)	27	30	13	14	18	16	25
Area Protected (acres)	2,800	760	820	1,500	1,100	230	295
Top Elevation of Wall (feet msl)	44.9	37.9	66.4	66.4	70.6	76.5	130.0
Raise Required (feet) to SPF level	--	4.3	4.4	4.4	4.7	5.7	3.6
Top Elevation of Dike (feet msl)	46.0	39.9	68.6	68.6	72.4	78.5	132.0
Raise Required (feet) to SPF level	--	4.3	4.2	4.2	4.9	5.7	3.6
Initial Construction Cost ($1,000) 1974 Price Level	$115,000[1]	$15,500	$6,800	$6,700	$10,800	$27,100	$7,300
Additional Cost to Raise ($1,000)	--	$ 6,700	$8,100	$10,000	$15,900	$15,100	$1,900

[1] Includes current estimate of Park River Conduit Modification, $71 million.

drainage within the diked area. At the northern end of the dike, the top elevation is 43.0 msl. From there, the top of the dike follows the slope of the design flood water surface, so that the elevation of the dike at the southern extent of the project is 39.1 feet. The height of the dike above the original ground surface varies from approximately 15 to 30 feet.

It is estimated that the earthen dike will have to be raised approximately 4.3 feet along its entire length to provide SPF protection. The concrete wall sections will also require a raise of about 4.3 feet. However, since the wall foundations were not designed to withstand the forces that could be applied to a higher structure, it has been assumed that the existing walls will have to be removed and rebuilt to the higher elevation. As the dikes do not meet present criteria, they may also have to be removed and rebuilt to the higher grade. In order to tie in to higher ground, it is estimated that the dikes will have to be extended a total of approximately 500 feet. An additional strip of land, approximately 15 to 30 feet wide along the entire length of the earthen dike, will also have to be acquired to accomodate the larger dikes.

Springfield, Massachusetts - The Springfield, Massachusetts local flood protection project consists of a combination of earthen dikes and concrete walls running approximately 15,200 feet along the east bank of the Connecticut River from above the Chicopee town line in the north to the South End Bridge in the south. There are three sections of earth dike totalling nearly 3,900 feet and five sections of concrete wall running approximately 11,300 feet. These dike and wall sections provide protection to approximately 820 acres of the most highly developed areas of Springfield. The top of wall elevation on the northern end is approximately 68.7 feet msl, and slopes gradually to 65.6 feet msl at the downstream end of the project. Within the protective works, there are also five stop log structures, along with six pumping stations for interior drainage. Through most of the Springfield area, the walls and dikes range in height from approximately five to thirteen feet.

In the Springfield area, a raise of about 4.4 feet will be required for the concrete walls and 4.2 feet for the earth dikes in order to provide Standard Project Flood protection. In addition, two extensions of the diking system, totalling 1900 feet, will be required in order to tie the protective works in to high ground. A narrow strip of land along the earth dike section will also have to be acquired to accomodate the larger dikes. Because of the magnitude

of the raise required, it will be necessary to remove the existing concrete walls and replace them with higher ones. As the dikes do not meet present criteria, they may also have to be removed and rebuilt to a higher grade.

West Springfield, Massachusetts - The City of West Springfield is protected from the flood waters of the Connecticut and Westfield Rivers by two sections of dikes and concrete walls. The Riverdale section parallels the Connecticut River in the northern portion of the city, while the West Springfield section runs along the north bank of the Westfield River and the west bank of the Connecticut River in the southern portion of West Springfield. In all, there are eight sections of earthen dikes with a total length of over 32,400 feet, and five sections of concrete floodwalls running over 3,900 feet, for a total of 36,400 feet of protective works. Approximately 1,500 acres of the city of West Springfield are protected by these flood barriers. At the upstream end of the diking system, the earth dike has an elevation of 73.8 feet msl and parallels the river as it slopes down to an elevation of 66.4 feet msl at the Memorial Bridge. Along this reach, the height of the dikes ranges from about five to fourteen feet above the natural ground surface. Drainage within the protected areas is handled by a system of five pumping stations. There are six stop log structures in the protective works.

As with the Springfield project across the river, a raise of approximately 4.3 feet will be required to provide Standard Project Flood protection to West Springfield. It is estimated that only about 300 feet of additional dikes will be required in West Springfield to tie in to higher ground.

Chicopee, Massachusetts - The Chicopee local protection project parallels the east bank of the Connecticut River and both banks of the Chicopee River at its mouth, for a total length of 26,800 feet. Within this total, there are 20,700 feet of earthen dike in five sections and 6,100 feet of concrete floodwalls in six sections. These structures provide flood protection for approximately 1,100 acres of the urbanized area of Chicopee. The interior drainage for this area within the dikes is handled by six pumping stations. At the northern end of the dikes, the top of dike elevation is 75.2 feet msl. The grade line of the dikes follows the gradient of the river as it flows south to the mouth of the Chicopee River, where the top of dike elevation is 72.3 feet msl. Through most of

the reach, the dikes average about 13 feet above the natural ground surface. These dikes also contain three stop log closures.

In order to provide Standard Project Flood protection to the city of Chicopee, it will be necessary to reconstruct the existing dikes and walls an average of 4.8 feet higher. This will require the complete reconstruction of the concrete floodwall sections, and the acquisition of a narrow strip of land paralleling the dikes to accomodate the large earthen structures. In order to tie the existing dike system in to higher terrain, it will be necessary to construct a number of dike extensions, particularly on the northern end in the Charbonneau Terrace area. A total of approximately 3,400 feet of dike extensions will be required.

Holyoke, Massachusetts - The Holyoke local protection project protects 230 acres of heavily industrialized area in the center of Holyoke. The project runs over 21,000 feet along the west bank of the Connecticut River and consists of four sections of earth dike running over 4,000 feet, and five sections of concrete floodwall totalling 17,000 feet. Included in these dikes and walls are 16 stop log closures for street and railroad openings. There is also a complex system of nearly 60 gates to prevent water from backing into the many mills. Seven pumping stations have been installed to dispose of the interior drainage behind the protective barriers. At the upstream end of the project, the concrete floodwall has a top elevation of 80.0 feet msl. At the downstream limit, near Riverside Park, the top elevation of the earth dike is 72.5 feet msl. Through most of the reach, the walls are about 13 feet above the natural ground surface.

In the Holyoke area, the local protection works will require reconstruction approximately 5.7 feet higher. More detailed surveys will be required to determine if a small berm is required in a 1300 foot section that is high enough for the present level of protection.

Northampton, Massachusetts - The protective works at Northampton consist of two main sections. The eastern section of dike protects the town from the floodwaters of the Connecticut River, while the western section seals off the town from floods on the Mill River. This section serves as a dam and diverts the waters of the Mill River into a diversion channel which discharges into Oxbow Lake. The total system includes 6,400 feet of earth dikes

and over 450 feet of concrete floodwall. There is one pumping station to handle interior drainage within the diked area and three stop log closures in the dike openings. The top elevation of the eastern dike ranges from 132.5 to 132.0 feet msl, while the top elevation of the dike paralleling the Mill River ranges from 146.2 to 139.8 feet msl. The dikes average about 21 feet above the natural ground surface.

In order to provide Standard Project Flood protection to the town of Northampton, it will be necessary to reconstruct the existing dikes approximately 3.6 feet higher. It is possible that a small berm extension to the dike will be required to tie in to higher ground.

Project Evaluation and Implementation

Cost estimates were prepared for the Coordinating Committee of raising the dikes at East Hartford, Springfield, West Springfield, Chicopee, Holyoke and Northampton. These estimates were examined and in some cases modified as part of the Supplemental Study. Work was done only to the extent necessary to provide a reasonable cost estimate. Existing wall and dike alignments were used. The concerned cities were not consulted about preferences as to alignment, type of protection, etc., realizing that such coordination is not necessary now, but will be a critical part of an authorization level study that will be required if Alternative 2 is pursued. Several assumptions were made in preparing estimates:

a. All wall sections involved would be removed and completely rebuilt. As the dikes do not meet present criteria, they may also have to be removed and rebuilt; however, for this study, it was assumed that dike sections would be stripped of surface material and rebuilt to a new level. Existing dike slopes would be maintained.

b. No new modifications to storm and sanitary drainage systems would be necessary.

c. Existing interior drainage pumping facilities would be adequate.

d. No new operational expenses would be incurred.

e. New land would be acquired in an amount equal to added land covered by the dikes and walls. This includes the land under

sections of new facilities as well as raised dikes and walls. Land value used was at a rate consistent with the value of land on the landside of the existing dike.

Cursory investigation of existing dikes indicated that no relocations of highways or utilities would be necessary.

The existing walls and dikes are tied into high ground. Estimates were made of new sections of dike or wall that would be needed to tie the works into high ground at the higher level of protection.

If a design should be undertaken of reconstructing these local protection projects, consideration would, of course, be given to adding width of dikes to the riverside of the projects. New alignments and changing from a dike to wall section or vice versa would also be considered to befit the existing development and the wishes of the community.

If Alternative 2 is pursued as a result of the Supplemental Study, serious consideration must be given to deciding which of the existing local protective works should be modified first. East Hartford, Springfield, and West Springfield have recently experienced the more rapid growth. However, it must be remembered that development behind all the dikes is extremely dense. Development behind the Chicopee dike, on the other hand, is mostly residential and, as such, probably represents a greater threat to life in the event of an overtopping. Implementation of the dike modification would depend upon the following:

a. The desire of the community -- No work could be undertaken until the community desired it and committed itself to certain assurances of cooperation.

b. The illustration of economic, environmental and social feasibility -- Survey reports, along with impact assessments would be prepared and forwarded to Congress.

c. Congressional authorization and funding.

Construction costs were updated using an Engineering News Record Construction Cost Index applied to estimates made as part of the Coordinating Committee Study. A 20% contingency factor was then applied. A design, construction and operational overhead factor,

which has been developed through experience on similar projects, was then applied. This latter factor varies with the magnitude of construction cost reflecting a lower rate on a higher construction expenditure. Land and damage figures were updated using current real estate values. Total project costs were then amortized using a 5-7/8% discount rate. A cost and annual charge summary are shown in Table 3.

Alternative 3 - Constructing a Reservoir at the Meadow Site and Reconstructing Existing Dikes

There are two major reasons for making a trial selection of a combination of dike reconstructions and a reservoir at the Meadow site. First, the Meadow has the best flood reduction capability of the seven reservoirs selected by the Coordinating Committee, it controls the largest drainage area and it is close to the major damage centers, a hydraulic advantage. Secondly, the Meadow site was selected because it is in Massachusetts, the state which has a major proportion of the Basin's flood problems. This latter point might provide the project with public and political support.

Table 4 indicates the construction cost and annual charge to do the reconstruction. The cost and annual charge of constructing Meadow would remain the same as they were in Alternative 1, that is $72,700,000 and $5,020,000, respectively.

The reader is referred to the Comprehensive Report, Appendix M, for a description of the Meadow Project. Costs are shown on Table 1 and flood control benefits are shown on Table 5.

The dikes have been discussed earlier in this section of the report. The reconstruction of the dikes would be similar to the reconstruction presented for Alternative 2 except that reconstruction under Alternative 3 would be to a lower stage than it would be for Alternative 2. Both alternatives would provide the same degree of protection for the diked areas, that is, Standard Project Flood. It was assumed that raising the dikes only the 1.8 to 2.5 feet necessary for Alternative 3 would necessitate a reconstruction rather than simply adding the necessary height to the existing structures. An examination of the structural analysis made in the 1940's may indicate that a reconstruction is not necessary in certain parts of the project; however, in view of the age of the projects, it

is felt that major items of reconstruction may be necessary on the projects in the latter part of the century. If the height is now to be increased, it will be economically expedient to combine the dike raising with an advance replacement project. The costs and benefits for the projects are based on this advance replacement concept which is described in Attachment C.

Alternative 3 provides $280,000 more flood reduction benefits than Alternative 2. The difference in benefits represents damages prevented downstream of the Meadow Site, but outside the mainstem local protection projects. On the other side of the ledger, the Alternative 3 annual cost exceeds the Alternative 2 annual costs by $4,096,000.

Alternative 3 does not provide a significant increase in benefits over Alternative 2; therefore, Alternative 2 is preferred because of the substantially lower cost. The higher cost of Alternative 3 is attributable to the fact that most of the reconstruction of the dikes would have to be undertaken even if Meadow was built, although the dikes would be reconstructed to a slightly lower elevation. The slightly lower elevations of Alternative 3 dike reconstructions (1.8 to 3.2 feet) would not be a significant factor in choosing between Alternative 2 and Alternative 3.

This combination of dike reconstruction with a reservoir, is not as efficient as providing the necessary flood protection with either a system of reservoirs (Alternative 1) or the dike reconstruction (Alternative 2). The Coordinating Committee recognized the more efficient approach of using the two techniques (reservoirs and dikes) separately and did not present an alternative with a mix of the two techniques.

TABLE 3

CONNECTICUT RIVER SUPPLEMENTAL STUDY
ALTERNATIVE 2
FEDERAL LOCAL PROTECTION PROJECTS

COST SUMMARY
SEPTEMBER 1974 PRICE LEVELS
(in $1,000)

Project	FEDERAL COSTS				NON-FEDERAL COSTS	Total Project Cost	Annual Charges
	Construction Cost	Contingencies	Engineering and Supervision	Total Federal Costs	Lands and Damages		
East Hartford	4,130	830	1,130	6,090	610	6,700	418
Springfield	5,100	1,020	1,350	7,470	630	8,100	506
West Springfield	6,240	1,250	1,570	9,060	940	10,000	624
Chicopee	8,960	1,790	2,170	12,920	2,980	15,900	992
Holyoke	9,830	1,970	2,350	14,150	950	15,100	942
Northampton	1,080	210	440	1,730	170	1,900	119
TOTALS	35,340	7,070	9,010	51,420	6,280	57,700	3,601

TABLE 4

CONNECTICUT RIVER SUPPLEMENTAL STUDY
ALTERNATIVE 3
FEDERAL LOCAL PROTECTION PROJECTS
COST SUMMARY
SEPTEMBER 1974 PRICE LEVELS
(in $1,000)

Project	FEDERAL COSTS				NON-FEDERAL COSTS	Total Project Cost	Annual Charges
	Construction Cost	Contingencies	Engineering and Supervision	Total Federal Costs	Lands and Damages		
East Hartford	3,580	720	970	5,270	530	5,800	362
Springfield	3,650	730	970	5,350	450	5,800	362
West Springfield	4,370	870	1,100	6,340	660	7,000	437
Chicopee	7,280	1,460	1,750	10,490	2,410	12,900	805
Holyoke	6,320	1,270	1,510	9,100	600	9,700	605
Northampton	980	190	380	1,550	150	1,700	106
SUB-TOTALS	26,180	5,240	6,680	38,100	4,800	42,900	2,677
Meadow [1]						72,700	5,020
					TOTAL	115,600	7,697

[1] See Table 1 for Cost Breakdown

TABLE 5

CONNECTICUT RIVER SUPPLEMENTAL STUDY
ALTERNATIVE 1
FLOOD DAMAGE REDUCTION BENEFITS

SEPTEMBER 1974 PRICE LEVEL*
(in $1,000)

Reservoir	Basic Benefit (1980)	Growth	Total Benefit
Gaysville Total	1,429	613	2,042
Mainstem	(1,186)	(497)	(1,683)
Tributary	(243)	(116)	(359)
Beaver Brook Total	162	52	214
Mainstem	(9)	(5)	(14)
Tributary	(153)	(47)	(200)
Victory Total	125	50	175
Mainstem	(83)	(34)	(117)
Tributary	(42)	(16)	(58)
Bethlehem Junction Total	321	134	455
Mainstem	(164)	(68)	(232)
Tributary	(157)	(66)	(223)
Claremont Total	564 ((530))**	241 ((220))	805 ((750))
Mainstem	(494)	(206)	(700)
Tributary	(70) ((36))	(35) ((14))	(105) ((50))
Honey Hill Total	244	108	352
Mainstem	(210)	(94)	(304)
Tributary	(34)	(14)	(48)
Meadow Total	3,974	1,550	5,525
Mainstem	(3,974)	(1,550)	(5,525)
Tributary	--	--	--
GRAND TOTAL	6,819	2,748	9,568
Total Mainstem	(6,120)	(2,454)	(8,578)
Total Tributary	(699)	(294)	(993)

* Engineering News Record Construction Cost Index 5 September 1974 = 2081.

** (( )) These figures represent benefits to the Claremont Project assuming that the Soil Conservation Service, Public Law 566 upstream watershed project, which includes 10 impoundments, is in place.

7. BENEFITS

Alternative 1 - With several exceptions, benefits presented in the 1970 Coordinating Committee Report were updated to 1974 price levels. An average of the inflation index and the Engineering News Record Construction Cost Index (ENRCCI) was applied for the period between June 1969 and September 1974. The resulting factor, 1.4, was used in updating except in the cases which follow.

In the case of downstream hydroelectric benefits, new benefits were furnished by the Federal Power Commission (Attachment B). The increase in the total downstream energy value from $42,000 annual in 1969, to $140,000 in 1974, is explained by the increase in fuel oil prices in the intervening period. It is assumed that the added hydroelectric energy provided by reservoir storage would replace energy now generated in oil fired steam-electric plants.

A design level study was undertaken on the Beaver Brook proposal after the Coordinating Committee Study was completed. Although the design level study was never completed due to withdrawal of local support, project benefit figures were developed at a survey level precision. Those benefit figures were updated from July 1972 to September 1974 (factor 1.18) and included in this report.

Updated flood damage reduction benefits, shown in Table 5, are subdivided by reservoir, mainstem and tributary, and by basic benefit and growth benefit. The breakdown of total project benefits for each of the seven reservoirs is shown in Table 6.

Alternative 2 - Before any benefits were assigned to the reconstruction of the dikes, benefits were calculated for the existing system of 16 flood control reservoirs in the Basin. Flood flow and stage reductions were calculated as well as the corresponding reduction in losses (benefits). After these benefits were assigned to the reservoirs, the remaining benefits behind each local protection project were assigned to that project.

After reconstruction of the dikes, the protected area would be safe for any flood up to the Standard Project Flood. Benefits were carried out to the .001 probability line on the damage - frequency curves.

The baseline condition for the dike reconstruction is with both the existing reservoirs and with the existing dikes in place. Benefits to the reconstruction are the incremental benefits from the base year to 1990. The year 1990 being the point in time when the project life of the existing project has expired (the projects were all constructed about 1940 with a 50 year project life). From 1990 to the year 2080, benefits will be credited to the dike reconstruction.

Attachment C presents the Alternative 2 benefits, an explanation of how the benefits were developed, as well as rationale and guiding documents which prescribe the technique.

Alternative 3 - The Alternative 3 benefits behind the mainstem local protection projects are the same as they are for Alternative 2. In either case, losses are completely eliminated up to a flood of the magnitude of a Standard Project Flood. Outside the diked area and on the mainstem of the Connecticut River, some losses will be eliminated by the Meadow Reservoir. The latter loss reduction is credited to the Meadow Project. Loss reduction credit behind the diked areas would be shared between the Meadow Project and the dike reconstruction.

Total project benefits for Alternative 3 are $6,624,000, whereas total annual charges are $7,697,000. The B/C ratio of 0.86 indicates that the project is not viable and benefits were not assigned among the elements of construction.

TABLE 6

CONNECTICUT RIVER SUPPLEMENTAL STUDY
ALTERNATIVE 1
BENEFITS FOR MAJOR RESERVOIRS

SEPTEMBER 1974 PRICE LEVEL
(in $1,000)

Projects	Flood Control	Recreation		Downstream Beneficial Uses						Land Enhancement	Total Benefits
		General	F & W	Water Quality	Recreation	F & W	Power	Fish Hatchery	Water Supply		
NEW HAMPSHIRE											
Bethlehem Junction	455	896	126	4	35	28	24	--	--	280	1,848
Claremont	805	812	42	22	29	14	13	--	--	280	2,017
Beaver Brook	214	13	--	--	--	--	--	--	152	--	379
Honey Hill	352	1,540	24	49	28	15	7	314	350	560	3,239
VERMONT											
Victory	175	466	80	--	28	4	83	--	--	--	836
Gaysville	2,042	802	126	--	56	56	13	--	--	658	3,753
MASSACHUSETTS											
Meadow	5,524	126	--	--	--	--	--	--	--	--	5,650
TOTAL	9,567	4,655	398	75	176	117	140	314	502	1,778	17,722

8. FINDINGS AND CONCLUSIONS

The following findings and conclusions are made within the context of the work that has been assigned to the Corps of Engineers; that is, to develop the structural components of flood damage reduction alternatives and to assess their flood damage reduction effectiveness. The Corps of Engineers finds:

A. There is a potential for flood losses throughout the basin; however, this potential is of far greater magnitude in the metropolitan areas of Springfield, Massachusetts, and Hartford, Connecticut.

B. A major flood could overtop the local protective measures in East Hartford, Connecticut; and Springfield, West Springfield, Chicopee, Holyoke, and Northampton, Massachusetts. The local protection project at Hartford, Connecticut was originally constructed to contain a design flood without the reduction from upstream flood control reservoirs and with the completion of the Park River Conduit Extension, the project will provide a high degree of protection for Hartford.

C. The areas behind the dikes are key areas in each community and all are heavily developed. Recent development in these areas ranges from heavy in the case of Springfield, West Springfield and East Hartford, to moderate in Chicopee and Northampton, and low in Holyoke.

D. Overtopping the protective works would be catastrophic. Enormous losses would be sustained and the New England Region, as a whole, would receive a crippling blow, both economically and socially. Many lives could be lost.

E. The three most likely structural solutions to the problems were examined. Two of these three solutions are viable from both an engineering and an economic standpoint. The existing system of sixteen tributary reservoirs can be expanded to twenty-three so that flood stages can be reduced to a point where the existing local protection projects will contain a modified design level

flood. On the other hand, the existing dikes and walls can be reconstructed so that they will contain a design level flood with the existing upstream flood storage capability.

F. The Corps is aware that the seven large reservoirs recommended by the Coordinating Committee no longer have the state and local support necessary to insure their implementation. Therefore, the Corps urges that another alternative plan of flood damage reduction be adopted to secure the previously mentioned communities. The Corps believes the only other viable alternative would be to reconstruct the six local protection projects at a higher level.

G. The mayors of the cities of East Hartford, Connecticut, and Springfield, Massachusetts, have requested that the Corps pursue the concept of raising their dikes.

H. That as soon as practical, the cities of Springfield, West Springfield, Chicopee, Holyoke and Northampton, Massachusetts, and East Hartford, Connecticut, be served notice that their local protection works will not secure the respective cities from a flood considered as a safe design flood. They should be further notified what, if any, measures are under way to correct this situation. This message should be issued annually both to the governmental authorities and through paid newspaper inserts in each city.

I. The Corps of Engineers, therefore, recommends that Alternative 2 -- Dike Reconstruction be pursued as a plan for alleviating the existing threat of dike overtopping in East Hartford, Connecticut, and Springfield, West Springfield, Chicopee, Holyoke, and Northampton, Massachusetts. To prevent these communities from being deprived of an acceptable level of protection any longer than necessary, it is further recommended that Type C studies be undertaken as soon as possible.

CONNECTICUT RIVER SUPPLEMENTAL STUDY
FIELD INVESTIGATION

NOVEMBER 1974

Field investigations were made in East Hartford, Springfield, West Springfield, Chicopee, Holyoke, and Northampton to determine, to the extent possible, recent development and development trends. Building permits and real estate assessment records were searched. The protected areas behind the dikes were visited and a photographic record was made of recent construction in each area.

The intent was to develop an estimate of construction in the protected areas since about 1969 and to estimate future growth potential in these same areas. The following sheets describe what was observed and include values of recent construction. The values are not all inclusive. Only major construction was included and values which were taken from building permits, and real estate assessments may not be complete and probably do not include furnishings and stock.

The work done pinpoints areas and time frames where heavy development has taken place and allows for a better projection of future development. More detailed analysis would be performed in subsequent Level C studies.

ATTACHMENT A

DEVELOPMENT AND GROWTH IN EAST HARTFORD, CONNECTICUT

Commercial and industrial growth has accelerated in the last ten years in the East Hartford local protection area. Construction is presently under way for new buildings, and with about 30 percent of the L. P. area still undeveloped, new construction and growth is expected to continue. With the assistance of the East Hartford Planning and Permits Department, 50 new commercial and industrial buildings, built after 1963, were identified in the L. P. area.

The southwestern quadrant of the L. P. area has experienced the most intensive growth with $25 - $30 million invested in an Urban Renewal Project, Founders Plaza. The project was initiated about 1969 with the construction of a 17-story office building, a 2-story parking garage, and a combination 2-story garage and 3-story office building. Following this initial construction, 7 other buildings were added to the project, including three office buildings (one under construction), a stationary and a glass company, a filling station, and an 8-story Ramada Inn (under construction).

The remaining new construction south of Connecticut Boulevard includes: an office and computer building on Ash Street, and seven commercial and office buildings on Pitkin Street. Older buildings have been replaced along Connecticut Boulevard by 12 new buildings, principally including auto sales and restaurants. North of Connecticut Boulevard, there has been an increase in commercial and industrial plants scattered through the residential area, totaling 19 new buildings or additions. A new housing development, including about 60 homes in the $30 - $40,000 range, was constructed within the SPF flood plain at the north end and outside the dike.

Attached is a list of the 50 buildings with street addresses and the year permits were approved.

RECENT CONSTRUCTION IN L. P. AREA, EAST HARTFORD, CONNECTICUT

Location	Building	Permit Value	Permit Year
Founders Plaza:			
100 Gilbert St.	Conn Bank & Trust	$4,000,000	1969
88 Gilbert St.	Parking Garage	1,500,000	1970
Gilbert St.	17-Story Ofc Bldg	4,000,000	1969
50 Hartland St.	K. L. I. BLDG.*	250,000	1972
5 Founders Plaza	Charter Oak Stationary	100,000	1973
60 Darlin St.	Shaw Walker Bldg	330,000	1974
131 Darlin St.	Shell Oil Company	50,000	1971
East River Drive	Ramada Inn	1,400,000	1973
Meadow St.	Melikian Bldg	-	1974
11 Village St.	Chase Glass Company	35,000	1972

*Appraised value $713,000; assessed value $463,000.

Location	Year	Building
45 Ash Street	1968	Office Building
111 Ash Street	1968	Computer Building
33 Connecticut Boulevard	1964	
45 " "	1963	
49 " "	1965	
65-67 " "	1965	
101 " "		
400 " "	1971	
411 " "	1972	Horseless Carriage
460 " "	1965	Dworin Chevrolet
477 " "	1966	Medical Arts Bldg
540 " "	1968	Burnside Motors
600 " "	1967	Calvin Ford
700 " "	1966	Hoffman Motors
162 Governor Street	1965	
180 Governor Street		Car Wash
296 Governor Street	1970	Warehouse
2 - 4 Lincoln Street	1965	
20 Village Street	1965	Clinton Iron Works
24 - 26 Village Street	1971	Warehouse
40 Village Street	1966	Hartford Tape & Label
200 Prospect Street	1965	Sterling Auto Body

Location	Year	Building
14 George Street	1966	
71 " "	1964	
80 " "	1965	
52 James Street	1965	
29 Charles Street	1966	
37 - 39 Charles Street	1965	
94 - 100 Charles Street	1966	"65" Inc.
34 Cedar Street	1966	Horst Eng. & Mfg.
41 Nelson Street	1967	
42 " "	1966	
16 Jencks Street	1971	Office & Warehouse

Town Owned Property

Permit #39569 - 8/2/68 Estimated Cost - $780.00 (E. H. Housing Authority)
1403 Main Street - 54 Unit Apt. Bldg. for Elderly.

39 Pitkin Street	1967	
101 " "	1963	Ward Bakery
119 " "	1967	Mickey's Drive In
131 " "	1966	Scullti
200 " "	1968	Bechenstein
222 " "	1968	Fisher Building
242 " "	1966	Westinghouse Bldg.

DEVELOPMENT AND GROWTH IN SPRINGFIELD, MASSACHUSETTS

Commercial, industrial and housing growth has boomed in the last four years alone in the Springfield local protection project at an estimated cost of $100 million. Thirty to fifty million dollars of this growth is attributable to an urban renewal project owned by the Massachusetts Mutual Life Insurance Company, which has constructed about a 25-story office parking garage and shopping center building, about a 15-story hotel and a 4-story parking garage at 1500 Main Street in downtown Springfield adjacent to city hall.

Additional buildings may be included in the project since overhead walkways lead to other buildings including one building on the opposite side of Main Street. The project appears to be in full operation.

Directly across Main Street from city hall, a new parking garage was built adjacent to a new Civic Center constructed about 1970 at an estimated cost of $9 million. Chestnut Park, located behind the Civic Center covering several city blocks appears to include a 10-story Motor Inn and possibly other buildings, constructed recently. Also, adjacent to city hall, about a six-story court house building is under construction.

North of 1500 Main Street near the I-91 and I291 intersection, several million dollars of new commercial buildings were built including a 2 and 3 story newspaper building covering several blocks, a new bus terminal, Blue Cross-Blue Shield building, several medical buildings, a Holiday Inn and Post Office.

In the northern half of the diked area about $40 million dollars of new construction has occurred in the last four years. About $20 million was financed for the construction of low income multi-family residences built adjacent to the dikes. Another $12 to $16 million financed a new school and medical building in the same area. Another million dollars of commercial and industrial buildings was constructed and is under construction in the northern protected area. Most of the development is along Avacado Street, where ample room remains for additional development. There is limited room for additional growth in the southern half of the dike area, although older buildings are being torn down for new construction. Besides new construction in the vicinity of city hall, extensive rehabilitation is under way at Carabetta Enterprises along Adams Street.

Attached is a partial list of new construction and alterations pointed out by the Springfield building inspector, containing addresses, estimated construction costs and year of permit.

RECENT CONSTRUCTION IN L. P. AREA, SPRINGFIELD, MASSACHUSETTS

Northern Half of Diked Area:

Location	Building	Est Con'n Cost	Permit Year
West St. 34-49	8 fam Multi-res	160K	1972
" " 52-62	8 " " "	120K	1972
" " 84-94	6 " " "	120K	1972
" " 66-80	8 " " "	160K	1972
	Interreligious Housing Corp.		
Washburn St. 41-140	six - 6 fam multi-res	820K	1971
	one - 8 " " "	158K	1971
	IHC		
Lowell St. 101	267 fam multi-res	4,812K	1972
" 35-133	three 6 fam multi-res	360K	1972
	three 8 fam multi-res	480K	1972
28-122	2 8 fam &1-10 fam IHC	515K	1971
	IHC		
Orchard St. 7-125	4-6-8 & 10 fam multi-res	1,188K	1971
Newland St. 96-110	8 fam multi-res IHC	158K	1971
" " 9-94	4-6 & 8 fam multi-res	713K	1971
Roseland St. 9	Spfld Redev Author		
	foundry building	11K	1971
Sanderson St	Spfld Hous Author		
67-69 115-7	multi-res	1,200K	1973
120-122	multi-res	157K	1973
Clyde St. 111-93	6 & 10 fam multi-res		
	5 bldgs IHC	852K	1971
97	Maint bldg IHC	14K	1971
Division St. 103-105	Medical office	82K	1971
98-100	multi-res SHA	40K	1970
92	Maint bldg	12K SHA	1971
Bond St. 100	347 multi fam res	7,000K	1972
	Spfld Redv Auth		
Birnie Ave 336	Mfg bldg Moore Co.	25K	1973
200	C of Spfld School	12,104K	1973

Avacado St. 90	Spencer, George & Co. Inc. Cold storage bldg	200K	1974
25	Warehouse & ofc & shop City Tire Co.	309K	1973
60	Simos Co., A Indus bldg	125K	1972
134	Goldberg, Ida & Naomi Meat storage bldg	148K	1970

South of I-291

Liberty St. 125	Ofc bldg Liberty Medical bldg Assoc	51K	1972
125	" " " "	53K	1973
125	" " " "	202K	1972
95	Stan. Photo-Technicolor Corp Photo studio & ofc bldg	755K	1972
11	Picknelly-garage bldg	283K	1971
Boylston St. 77	Pearson Blue Dev Co. ofc bldg	225K	1974
Main St. 1500 near City Hall	No's incr from S to N		
1500	Store & ofc bldg-Ma Mutual L. I.	43K	1974
"	Swimming Pool	65K	1974
870	Restaurant	15K	1974
2547	Storage bldg-Ann Assoc	16K	1974
1216	Katz-store bldg	6K	
1319	Alt Bank bldg-Comm Sav Bank	50K	1973
2203	Mercantile bldg-Gasland Inc	47K	1973
1500	Alt ofc bldg-Ma Mutual L. I.	81K	
1500	Alt store & ofc " Store G-29	133K	1972
1500	Alt store & " Store G-36	131K	1972
1414	Alt store-Forbes & Wallace	195K	1972
1500	Alt ofc bldg-Ma M L I	295K	1972
1531	Alt ofc Zeller, Eugene &	48K	1971

1500	Alt store & ofc MA M L I	95K	1971
1500	Alt store & ofc-Foodamerica Corp	64K	1971
1449	Alt store bldg	91K	1971
1860	Newspaper plant Republican Co.	91K	1971
1500	Alt store & ofc-Friendly Ice Cream	41K	1971
1500	Alt store & ofc-Wilbar's	28K	1971
1500	Alt store & ofc bldg-MA M L I	444K	1971
1500	Hotel-MA. M L I	4,250K	1970
1500	Stores & garages-MA M L I	8,500K	1970
40-50	Cafe bldg-Kitelos	55K	1970
1277	Civic Center-C of Spfld	9,000K	1970

This list does not include all alterations at 1500 Main Street during the last four years.

Buildings Omitted -

Post Office
Medical bldg(s)
Blue Cross-Blue Shield
Holiday Inn
Extensive Rehab at Carabetti Enterprises
New Court House
The Jefferson Newspaper
Chestnut Park

DEVELOPMENT AND GROWTH IN WEST SPRINGFIELD, MASSACHUSETTS

Commercial and industrial development in West Springfield has experienced moderate growth in the last five years. Construction permits were approved for about $5 million for the main dike area and $7.1 million for the Riverdale dike during the 1968 to June 1974 period. Future growth is limited for the main dike; however, the Riverdale area has ample room remaining for new development.

In the main dike area, the northern half has experienced the most growth with an estimated construction cost of $3 million including $314,000 for renovations at the Town Hall. Ten new buildings were built along Elm Street with an estimated construction cost of $1,691,000. The buildings include office, apartments and furniture buildings and one motel. Van Deene Avenue, Westfield, and Central Streets in the vicinity of Town Hall received about $1,030,000 of new construction including the construction of new fire station for $439,000. Other buildings include gas stations, office buildings, a bank, and drug stores.

The south half of the main dike was scattered with about 25 new buildings or additions with an estimated construction cost of $1,960,000. The buildings consist primarily of warehouses, service stations, office buildings and restaurants.

The Riverdale dike has been set aside by the West Springfield Planning Board for business and industrial parks. Several large structures account for about 80% of the $7.1 million of the total estimated construction cost. A motor inn was built for $2,084,000, a motel and restaurant for $1,430,000, three apartment buildings for $1,294,000, and an $800,000 ice skating facility. The remaining buildings include a car dealer, service stations, restaurants, warehouses, a package distribution center, office buildings, a theatre, and a church.

Attached is a list of the new developments with street addresses, estimated construction costs and the year permits were approved.

RECENT CONSTRUCTION IN L. P. AREAS

WEST SPRINGFIELD, MASSACHUSETTS

MAIN DIKE AREA (NORTH): 1968 to June 1974

Address	Building	Estimated Construction Cost	Permit Year
1533 Elm Street	Cross Roads Motel	$ 40,000	1972
1121 " "	Office Building	443,000	1972
1144 " "	Apartments	90,000	1972
352 " "	Building	40,000	1972
1252 " "	Office Building	250,000	1969
82 " "	Office Building	18,000	1968
82 " "	Furniture Store	185,000	1968
82 " "	Furniture Store	250,000	1968
82 " "	Apartments	250,000	1968
1111 " "	Office Building	125,000	1974
572 Westfield	Gas Station	131,000	1972
1130 "	Drug Store & Dentist Office	145,000	1972
668 "	Drug Store - addition	15,000	1974
Westfield & Van Deene	Bank	190,000	1970
93 Van Deene Avenue	Office Building	80,000	1968
44 " " "	Fire Station	439,000	1972
26 Central Street	Town Hall - Renov.	314,000	1970
3 " "	Gas Station	30,000	1970

MAIN DIKE AREA (SOUTH):

Address	Building	Estimated Construction Cost	Permit Year
989 Memorial Avenue	Banquet Hall	$100,000	1972
1039 " "	Car Wash	22,000	1972
312 " "	Auto Tune Up	20,000	1971
-- " "	Shopping Center	150,000	1970
1023 " "	Gas Station	40,000	1970
-- " "	Retail Store - 11 Story	350,000	1969
1226 Union Street	Repair Building	250,000	1974
1361 " "	Warehouse	30,000	1972
1311 " "	Office - addition	30,000	1972
58 " "	Service Station	25,000	1971
184 " "	Restaurant	37,000	1970
966 " "	Mercantile Building - add.	29,000	1969
400 Main Street	Auto Body Shop	18,000	1972
673 " "	Restaurant	60,000	1971
615 " "	Storage Building	10,000	1968
126 Baldwin Street	Wholesale Distr. Bldg.	38,000	1972
138 " "	Stock Room	14,000	1972
35 River Street	Dental Office & Apartments	38,000	1971
Bliss Street	Warehouse	360,000	1969
Barnard & New Bridge	Office & Service Shop	60,000	1969
9 Agawam Street	Building	50,000	1968
210 " "	Warehouse	116,000	1974
E. States Expo	Storage	12,000	1968
140 Norman Street	Manufacturing	46,000	1968
49 Heywood Street	Warehouse	55,000	1974

RIVERDALE DIKE: 1968 to June 1974

Address	Building	Estimated Construction Cost	Permit Year
885 Riverdale Street	New Car Showroom	$ 135,000	1974
1068 " "	Restaurant	45,000	1973
1080 " "	Motor Inn	2,084,000	1972
1150 " "	Motel & Restaurant	1,430,000	1972
2131 " "	Retail Showroom	50,000	1973
2071 " "	Apartments	475,000	1971
644 " "	Restaurant	79,000	1970
864 " "	Theatre	276,000	1970
948 " "	Restaurant - add.	10,000	1970
1285 " "	Supply Room - add.	14,000	1970
1268 " "	Gas Station	28,000	1969
1048 " "	Restaurant	36,000	1969
1107 " "	Restaurant	40,000	1969
1247 " "	Service Station	40,000	1969
777 " "	Service Station	36,000	1969
586 " "	Business - add.	42,000	1969
Myron Street	Business Building	52,000	1967
" "	Warehouse	75,000	1968
" "	Warehouse	35,000	1968
120 Wayside	Package Distri. Center	300,000	1974
"	Office Building	25,000	1970
139 "	Office & Warehouse	32,000	1970
Dotty Circle	Warehouse	23,000	1969
" "	Warehouse	30,000	1967
" "	Warehouse	38,000	1968
109 Ashley Avenue	3-story Apartment	540,000	1972
124 " "	Warehouse - add.	22,000	1969
Capitol Drive	Springfield Olympia Co. Ice Skate Facility	800,000	1972
575 Morgan Road	Church	40,000	1971
Craig Drive	Apartments	279,000	1968

DEVELOPMENT AND GROWTH IN CHICOPEE, MASSACHUSETTS

The development and growth within the Chicopee main dike local protection area has been limited primarily to residential construction. New homes in the last five years have been constructed at a maximum rate of 30 to 35 homes per year, with a $30 to $70,000 price range (per building inspector). However, that rate has or will drop since very little room remains for further development.

Between 1965 and 1968, about $1 million financed new apartment buildings and multi-family residences along Chicopee Street.

Commercial and industrial growth is limited primarily along the two main streets in the L. P. area, Chicopee and Meadow Streets. In the last ten years, Meadow Street has experienced about $1 million in commercial growth, including a new shopping center, two banks, a storage building, a food processing plant and additions to factory buildings and a super market. In addition, a new school was built at 704 Meadow in 1970 with an estimated construction cost of $2,243,000. During the same period, Chicopee Street experienced only about $115,000 of commercial growth, including two car washes, a shoe repair shop, and additions to a machine shop and a cafeteria. Commercial growth is limited due to the lack of available space.

There hasn't been any new development in the Chicopee dike located along the south bank of the Chicopee River.

Attached is a list of the major developments and additions, with street addresses, estimated construction cost and year permits were approved.

RECENT CONSTRUCTION IN L. P. AREA, CHICOPEE, MASSACHUSETTS

Address	Building	Estimated Construction Cost	Permit Year
366 Chicopee Street	Cafe Alter.	$ 19,500	1965
1011 " "	Car Wash	17,500	1969
265 " "	Two Apartments	560,000	1968
524 " "	Shoe Repair Shop	15,000	1972
526 " "	Car Wash	20,000	1965
267 - 269 " "	Two 16-Family Dwellings	150,000	1965
939 " "	Add. Machine Shop	43,000	1971
508 " "	13 Apartment Buildings	110,000	1966
" "	Six 2-Family Dwellings	78,000	1965
725 Meadow Street	Super Market	260,000	1962
725 " "	Super Market - Alt. Add.	200,000	1971
134 " "	Renov. Bar & Lounge	35,000	1974
153 " "	Bank	90,000	1974
134 " "	Dine & Dance Hall	20,000	1962
680 " "	Add. to Mfg. Building	30,000	1971
919 " "	Food Process Plant	46,000	1971
704 " "	School	2,243,000	1970
" "	N. E. Container Co. Add.	19,000	
521 " "	Baler & Storage Building	25,000	1966
739 " "	Shop Center	500,000	1971
705 " "	Add. to Warehouse	200,000	1962
" "	Add. to Factory Building	20,000	1965
751 " "	Bank	90,000	1972

DEVELOPMENT AND GROWTH IN HOLYOKE, MASSACHUSETTS

The Holyoke local protection project has experienced very little growth in recent years. The last major development was the Springdale Industrial Park built in 1956 including about ten new buildings. In 1972, the Marvellum Company - Division of Ludlow Corporation constructed a new building estimated at $1,025,000 for paper manufacturing. The Brown Paper Company constructed an addition to house two new boilers at an estimated cost of $1,000,000, in 1974. The only other major development in the last ten years was a sewage treatment plant constructed in 1964 at an estimated cost of $1,205,000. Another sewage treatment plant is scheduled for completion in three years, which will be located within the local protection area. Although a new interstate by-pass is expected to be built through the local protection project in the near future, very little growth is expected due to the limited area available for new development.

Attached is a list of the major new developments and a partial list of additions with street addresses, estimated construction cost, and the year permits were approved.

RECENT CONSTRUCTION IN L. P. AREA, HOLYOKE, MASSACHUSETTS

New Developments:

Location	Building	Estimated Cost	Permit Year
111 Mosher St.	Marvellum Co. - Div of Ludlow Corp. Paper Mfg	$1,025,000	1972
28 Appleton St.	Marvellum, warehouse	65,000	1966
74 Main St.	Atlantic Richfield gas station	24,000	1970
Berkshire St.	Sewage treatment plant	1,205,000	1964
Canal & Appleton St.	Marvellum -	200,000	1963
Jackson St.	Alles Realty Trust garage and office	80,000	1963
911 Main	Mid-Dale Inc. storage garage & repair	40,000	1963
Springdale Industrial Park (Approx. 10 new buildings in 1956			
821 Main	Acme Chain Co. Factory	275,000	1956
Race & Stebbin St.	Holyoke Water Power Mfg	80,000	1956

Additions or Improvements:

10 Eagle-A Ave	Brown Paper Co. Eagle-A /Div 2 new boilers	$1,000,000	1974
700 Main St.	Sun Oil Co.	9,000	1967
686 Main St.	Univac-Div of Sperry Rand	30,000	1967
2 Cabot	Ruck's Inc. car service	30,000	1966
Jackson	Holyoke Wtr Power	35,000	1966
709 Main St.	Gravure & Graving Corp	13,000	1965
"	"	20,000	1966
221 Appleton	Lestoil	40,000	1964

DEVELOPMENT AND GROWTH IN NORTHAMPTON, MASSACHUSETTS

The Northampton local protection area has experienced a growing surge in the last five years. Most of the new construction is located along Conz Street which furnishes homes for the elderly. Two new high rises, seven to eight stories, were built at an estimated $2 to 3 million each. Nine new multi-family residences were also constructed at an estimated $50,000 each. Also on Conz Street, a veteran club has constructed a $20,000 club house.

New construction along King Street includes two new office buildings and a maintenance building for Bell Telephone estimated at $1 million. An engineering firm has constructed a $50,000 office building also on King Street. At the intersection of King Street and Interstate 91, a large Howard Johnson's Motor Lodge and Restaurant was built, year unknown.

Future development is limited by the small area protected by the dike.

A new motel has been constructed between the dike and the Connecticut River on Hockanum Road.

MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : STUDY MANAGER - CONNECTICUT RIVER SUPPLEMENTAL STUDY

DATE: Oct. 31, 1974

FROM : REGIONAL ENGINEER, NEW YORK

FEDERAL POWER COMMISSION
REGIONAL OFFICE
26 FEDERAL PLAZA
NEW YORK, NEW YORK 10007

SUBJECT: Energy Impact Evaluation

We have reviewed the various alternative flood damage reduction plans for the lower basin main stem and the various sub-basins in the Connecticut River Basin and have evaluated their effects on power. In order to facilitate that evaluation, the various alternative floodplain management proposals and their combinations were divided into the two broad categories of non-structural and structural.

The non-structural approach to floodplain management will have the least effect on land and water resources and seems at this time to have developed the most public support. The proposed non-structural alternatives appear to have no immediate effect on the production of energy. It is possible however, that structures such as power plants, transmission lines, distribution stations, and some ancillary facilities are presently in the Intermediate Regional Flood (IRF) floodplain and others may be contemplated. These essential facilities should be included in the evaluation of floodplain damage potential under the "Maximum" program alternative. The possibilities of not being able to site future structures in the floodplain and the removal of existing equipment could present difficulties in power production and transmission capabilities. This could add substantially to electric power costs.

The structural alternatives examined indicate that the installation of power generators at any of the seven (7) presently proposed dams are not presently economically justifiable; as was the case in the original Connecticut River Basin Study. However, power benefits will accrue from the construction of the seven projects. Low-flow releases, as proposed in the Corps' plan, will augment the natural flows and provide additional quantities of water for power use at successive existing downstream hydroelectric generating stations.

We have re-examined Table 22 on Page M-1-146 in Volume VIII of the Connecticut River Basin report and have updated on the enclosed Table 1, the information pertaining to electric power. The downstream benefits

5010-106

ATTACHMENT B

assigned to power were evaluated at $42,000 in the CRB report. In view of current system fuel costs, this benefit is now estimated to be $140,000 at July 1, 1974 price levels. This benefit accrues from upstream releases of water and allows for the additional generation of 14 million kilowatt-hours annually of pollution free energy. It also represents savings of about one million gallons of vitally needed oil.

Also shown on Table 1 is the possibility of utilizing the permanent pools at the proposed reservoirs for their use as cooling ponds in association with the siting of fossil power plants. However, no attempt was made to analyze the use of these facilities that would be referenced to ecological or other environmental considerations. In some cases, additional capital costs would be required to provide a technically sound intake structure. Further study would also be required to determine dam modifications that would provide a higher level winter pool. Only the Victory, Honey Hill and Bethlehem Junction ponds appear to be within the size criteria that utilities would consider for siting power facilities. Pumped storage combinations using any of the proposed reservoirs, at present, do not look attractive. Numerous other possible pumped storage sites of much greater potential exist in the Connecticut River Basin and vicinity. Many of these sites have been investigated by NERBC in their peaking study.

A. M. Monaco

Enclosure

cc: Chief, Bureau of Power
Mailing List, Attached

PWR-NYRO
Barish, J.:rd
10/31/74

TABLE 1

CONNECTICUT RIVER SUPPLEMENTAL STUDY

ENERGY IMPACT EVALUATION

PROJECT NAME	Average Annual Downstream Energy (MWh)	Connecticut River Basin Study Value ($/Year)	1974 Value ($/Year)	Equivalent Oil (Gal./Year)	Surface Area (Acres)	Thermal Capacity (Megawat
Meadow	-	-	-		-	-
Claremont	1330	4000	13300	95000	860 1/	430
Gaysville	1330	4000	13300	95000	640 2/	320
Honey Hill	670	2000	6700	47900	970 1/	485
Beaver Brook	-	-		-	203 1/	100
Bethlehem Junc.	2340	7000	23400	167100	1090 1/	545
Victory	8330	25000	83300	595000	2880 1/	1440
TOTAL:	14000	42000	140000	1000000		

1/ Summer Conservation Pool

2/ 1 May to 15 Nov.

CONNECTICUT RIVER BASIN STUDY

Copies to:

Mr. Philip Cheney, President
Cheney, Miller, Ellis & Assoc., Inc.
135 Main Street
Putnam, Conn. 06260

Dr. Ruth Mack
Director of Economic Studies
Inst. of Public Administration
55 West 44th Street
New York, N. Y. 10036

Mr. John T. Smith
Policy & Long Range Planning Branch
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Mass. 02154

Mr. Charles H. Dingle
Ass't. State Conservationist
U. S. Dept. of Agriculture
Soil Conservation Service
Federal Building
Durham, New Hampshire 03824

Mr. Stephen Tibbetts
Envrionmental Engineer
State of Connecticut
Dept. of Environmental Protection
Room 207, State Capitol
Hartford, Conn. 06115

Mr. Emerson Chandler
Chief Planner
Commonwealth of Massachusetts
Water Resources Commission
100 Cambridge Street
Boston, Massachusetts 02202

Mr. William Hoffman, Principal Planner
State of New Hampshire
Office of Comprehensive Planning
State Office Bldg.
Concord, New Hampshire 03303

Mr. Robert Wernecke, Chief, Hydrology Section
State of Vermont, Agency of Environmental Conservation
Dept. of Water Resources
Management & Engineering Division
28 School Street
Montpelier, Vermont 05602

Professor Bernard B. Berger, Director
Water Resources Research Center
University of Massachusetts
Graduate Research Center, A-211
Amherst, Mass. 01002

Mr. John J. Curry
30 Flax Mill Lane
Milford, Connecticut 06460

CONNECTICUT RIVER SUPPLEMENTAL STUDY

ALTERNATIVE 2

ECONOMIC ANALYSIS

The basic flood protection plan for the Connecticut River Basin called for a system of 20 reservoirs and 1 local protective works at seven of the principal damage centers in the lower basin. The system was authorized as an interdependent one, with the design of the local works being predicated on protecting against flood flows as modified by the 20 reservoir system. Because of the flood history of the basin, that is, three major floods (1927, 1936, and 1938) in 12 years, construction of the seven local protective works was carried out in the period 1938 - 1941, along with the construction of five of the smaller authorized reservoirs.

For six of the seven principal damage locations, namely, the cities of Holyoke, Chicopee, Northampton, Springfield and West Springfield in Massachusetts, East Hartford in Connecticut, the design of the local works was based on a design flood which closely approximated the current SPF as modified by the 20 reservoir system. At the seventh location, the city of Hartford, local interests were unwilling to wait for construction of the authorized reservoir system and requested that the protective works be designed to meet the design flood, unmodified by reservoirs -- i.e., 6 feet higher than the authorized plan. As Hartford was willing to pay the additional cost (and did) the extra height was added at Hartford and that city today has a very high degree of flood protection.

Since the early forties, 11 additional reservoirs have been constructed in the basin, but three of these are completely local in nature on small tributary streams and two others were built as a substitute for a larger, more effective reservoir in the authorized plan. On the average, the present system of reservoirs reduces flood flows by 20 percent in the area where the local protection works are located.

The report of the Connecticut River Comprehensive Study, a Level B (formerly Type II) undertaking, was published in 1970. The report recommended the construction of seven additional reservoirs (i.e., added to the existing 16 reservoirs) which could approximate the effect of the authorized system in reducing flood flows in the local protection areas to the point where local works would be safe in an SPF. As an alternative, the report considered raising the existing walls and dikes to an elevation which would protect against the SPF as modified by the existing system of 16 reservoirs.

ATTACHMENT C

In 1972, the Water Resources Council directed that a supplemental study be undertaken to review the Comprehensive Survey. The Supplemental Study has reviewed the environmental aspects of the recommended flood damage reduction plan and considered alternative flood control measures, since the recommended reservoirs were encountering major opposition from the upstream States and local interests. The Supplemental Study is now drawing to a close. As part of the review, meetings were held with State officials, local officials and interested citizens throughout the basin. It was established that there was practically no support for the construction of reservoirs in any of the areas where they were to be located, and that one State, Vermont, is formally opposed to the two reservoirs recommended in that State.

The present attitude of the citizens in the upper Connecticut River Basin States, with regard to the construction of flood control dams, militates against achieving SPF protection in the lower basin except by local protection works. In the case of the existing local protection works built as part of the authorized system for flood control in the basin, there is a special obligation on the part of government, both national and local, to achieve SPF protection, because in the interest of economy and speed of construction, these works were designed and built early to elevations based on the entire system being constructed. Under the assumption that such protection was assured, there has been a large amount of construction in these areas vulnerable to overtopping by floods of less than SPF magnitude. Loss in such an event could be catastrophic and would probably involve loss of life. Section 77-b of EM 1120-2-101 requires that, "Because of the type of flood hazard involved, flood control projects for urban areas in general will be designed to provide protection against the Standard Project Flood whenever that extent of protection can be provided within the limits of cost justified by the tangible and intangible benefits".

That floods of a magnitude approaching the SPF are a probability, can be realized by studying the flood history of the second and third quarters of the twentieth century. There have been four major floods in the Connecticut River Basin in that time and numerous lesser events. Of the major floods, only the event of March 1936 was produced by a storm which covered the entire basin. The duration and intensity of rainfall in this storm were not record breaking, but the melting of a heavy snow cover, especially in the upper and middle portion of the basin, was a major factor in making this event the flood of record.

The other three floods were caused by rainfall alone. In November 1927, the rainstorm was intense and of long duration, but the storm was centered outside the basin and only the western portion of the basin got the bulk of such rain as fell. The flood generated by the storm caused the third highest stage of flooding of the period in the Hartford-East Hartford area. In 1938, the rains associated with the Great New England Hurricane, while partially centered over the lower middle portion of the basin caused the second highest flood stages of the century in the Hartford area. In August 1955, the rainfall of Hurricane Diane centered just to the north of the Hartford area produced flood stages there which approximated the 1927 event. In all, only the lower 30 percent of the basin was subject to this storm, but the peak run-off at Bodkin Rock was 66 percent of the peak run-off from the record basin-wide flood of March 1936 at the same location. It should be noted that studies made following this event show that the storm exceeded the Standard Project storm for southern New England as developed from Civil Engineer Bulletin 52-8 in all areas.

A detailed analysis was made of the local protection for the city of Springfield. Total annual losses in Springfield at the time of the review for the Comprehensive Survey (1967-1968) were $900,000. Since that time, Urban Renewal Programs, combined with the construction of Interstate Highway I-91 through the flood plain has removed much of the blight that was in the area and replaced it not only with the highway, but also with new and high value building construction. Based on a flood damage review of the area in November 1974, by a damage analyst, long familiar with the area, it is estimated that recurring and annual losses have doubled so that annual losses would be $1,800,000 at 1968 price levels.

The protective works at Springfield consist of a combination of walls and dikes with the dikes generally two feet higher than the walls. The effective height of the walls is elevation 63.4 feet msl. The 100-year flood, as modified by the existing reservoir system has an elevation of 63.5 + feet msl. The 200-year event, elevation 65.8 + feet, msl, as modified by reservoirs, encroaches on the freeboard of the wall and lacks only 0.8 feet of overtopping. As protection, the reservoirs are not considered effective beyond that point. In the benefit analysis, the reservoirs are credited with the full flow reduction of 20 percent from the annual flood to the 200-year event or $1,036,000. On this basis, the local works are credited with the residual in this range or $300,000.

The SPF, as modified by the existing system of reservoirs, has an elevation of 69.5 feet msl and a frequency of 0.10 percent. The benefits from the 0.5 percent frequency to the 0.10 percent are credited to the

local works. Benefits so derived amount to $306,000. The total benefit to the local protective works amounts to $606,000 1968 price level or $848,000 1974 price level and is credited to raising the works to achieve SPF protection.

The right to claim the benefit is based on Section 13, "Advance Replacement of Existing Improvements," especially paragraph c, Limit of Extended Benefits of EM 1120-2-104, "Survey Investigations and Reports, Computation of Financial Costs and Economic Costs." As previously noted, the local works were built in 1940, with a project life of 50 years. By 1980, the base year for implementing the new projects, the existing project will be 40 years old, or 80 percent through the original 50 year project life. Paragraph 13c, referenced above, notes that, where the replaced facility serves a project purpose such, for example, as flood control by a non-Federal levee, the benefit is the full amount of the extended flood control benefits (not limited by cost of replacing the existing facility).

That is exactly the situation which exists with the raising of the walls and dikes at Springfield; therefore, the entire benefit for the existing local protection and the benefit to the new higher, local protection are credited to raising the dikes and walls.

A similar approach was used for the other five local protection areas. The following table presents project costs, annual charges and annual benefits at 1974 price level for each of the six communities on the main stem Connecticut River which have been authorized, but have not yet received Standard Project level protection.

Community	Project Cost (in $1,000)	Annual Charges (in $1,000)	Annual Benefits (in $1,000)	B/C
Springfield, MA	8,100	506	848	1.7
West Springfield, MA	10,000	624	4,304	6.9
Chicopee, MA	15,900	992	140	0.1
Holyoke, MA	15,100	942	207	0.2
Northampton, MA	1,900	119	86	0.7
East Hartford, CT	6,700	418	759	1.8